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Statistical analysis of the parameters of gamma-ray bursts with known redshifts and peaked optical light curves

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Abstract

© 2015, Pleiades Publishing, Ltd. We present the statistical analysis of the properties of gamma-ray bursts with measured host galaxy redshifts and peaked optical light curves in proper frames of reference. The optical transients are classified by comparing the time lag of the optical peak relative to the GRB trigger with the duration of the gamma-ray emission itself. The results of the correlation analysis of all possible pairs of energy, spectral, and temporal characteristics of both gamma-ray and optical emissions are given. We specify the pairs of the parameters with correlation coefficients greater than 50% at significance levels better than 1%. The following empirical relations, obtained for the first time, are specifically discussed: a correlation between the peak optical afterglow R band luminosity and redshift $LR \propto (z+1)^{5.39\pm0.74}$ and a correlation between the peak luminosity of the prompt optical emissions and the time of the peak $LR \propto Tpeak^{-3.85\pm1.22}$. We also analyze the similarity of the relationships between the peak optical luminosity and the isotropic equivalent of the total energy of gamma-ray bursts for afterglows ($LR \propto Eiso^{1.06\pm0.22}$) and for prompt optical emissions ($LR \propto Eiso^{1.59\pm0.21}$).

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Keywords

gamma-ray burst: general, methods: statistical